Modern Issues in Environmental Science

An Honors Project (HONRS 499)

by

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ABSTRACT

This project is a compilation of material which is meant to be used within the classroom by the secondary science teacher. The material within this thesis contains course rationale, unit objectives for each plan, and lesson plans to accompany each unit. Lists of sources will be included, which will be an invaluable resource for any classroom teacher. The five topics of study will be as follows: **Habitat destruction, Endangered species, Global warming, Overpopulation,** and **Pollution.**

Course Rationale

This course, *Modern Issues in Environmental Science*, is meant to be used at the secondary science level. Its purpose is to introduce students to topics which are widely debated in the scientific community, as well as in wider society. The issues which will receive attention within the course study are those which effect students today, and will continue to effect students in the future. Students will be asked to apply their pre-existing scientific knowledge to new types of situations, particularly those which require decision making and problem solving.

The course will concentrate on student-centered activities and discovery learning, so that each student will learn through his or her own initiative or research. Also, learning tools such as the microcomputer and audio-visual material will be used in order to make learning more fun for both the students and the teacher. Several times within the six week time span for which this mini-course is designed, students will be asked to give brief presentations of their findings. Also, students will be required to give comparative analyses of opposing scientific opinions in the form of classroom debates.

Although this is a short version of an actual high school course, it can be drawn from, either as a resource for various units within a larger

course of study, or it may be extended or elaborated upon in order to create a more inclusive list of topics for environmental science classes. My reason for tackling this project is one which many people may be unaware of. After searching through various resources for secondary education, it occurred to me that although teachers spend a lot of time on the basic principles in science, somewhere along the line the application part of science sometimes gets lost. I have made an attempt with this course to show students that applying science to their lives is both fun, and more importantly, necessary in today's everchanging world.

REQUIRED TEXTS AND RESOURCES FOR THIS COURSE

Kaskel, Albert. Laboraty Manual: Biology : an everyday experience. Macmillan/McGraw-Hill, Lake Forest, Ill., 1992.

The following pages will be used within this course. They will be used from the lab manual which must be purchased in order for the activities to be available to students: "How does thermal pollution affect living things?" P.271-274.

"How do chemical pollutants affect living things?" P. 267-270.

Kormondy, Edward J. Biology: a systems approach, laboratory manual. Addison-Wesley publishing, Reading, Mass., 1988.

The following labs have been used within this unit. The lab manual must be purchased in order for the students to perform the activities.

"Sampling a plant community." P.325-328.

"Population Growth." P.315-319.

"A predator-prey simulation." P.307-313.

Project Wild: secondary activity guide. Western regional environmental council, 1986.

The following activities have been taken from the the project wild secondary resource book. A teacher must be project wild certified in order to perform the activities in class:

"Habitrekking." P.57-58.

"OH Deer." P.107-110.

"No water off a duck's back." P.119-120.

"Flip the switch for wildlife." P.129-130.

"Adaptation artistry." P.91-92.

"Pond Succession." P.95-96.

"Here today gone tomorrow." P.115-118.

Project Wild: Aquatic activity guide. Western Regional Environmental Education Council, 1987.

The following activities have been taken from the project wild aquatic activity guide. A teacher must be certified by project wild in order to utilize these activities.

"Dragonfly Pond." P.143-147.

"Fashion a Fish." P. 81-83.

"Where have all the salmon gone?" P.103-107.

Haslam, Fred. SIMEARTH. MAXIS Software, 1991.

This software must be purchased by the manufacturer in order to be used within the classroom. Copying of this software is a severe copywrite infringement.

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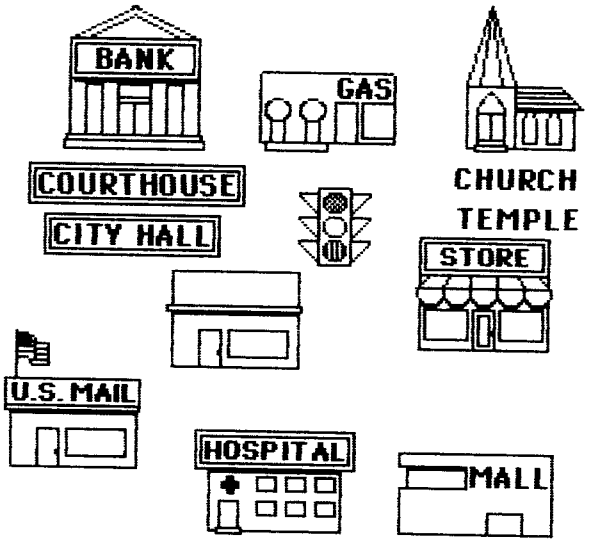


DESTRUCTION********

Unit Objectives: Habitat destruction

During this five day unit of study student will achieve the following instructional objectives:

1. Describe how ecologists survey the diversity of plant communities in forests.
2. Tell how man-made structures effect the habitat and animal populations in their own communities by surveying the local landscape.
3. Present findings from the Habittrecking exercise in an organized, well-thought, and easily understandable group project.
4. Participate in a role playing exercise concerning the spotted owl controversy.
5. Present well-thought opinions about the spotted owl controversy and support those opinions with facts about the animal's habitat.
6. Participate in an exercise in which students will design an artificial habitat for an assigned animal.
7. Create a drawing of the artificial habitat and present the reasoning behind their design in an organized group presentation.
8. Write a one page essay on how the past activities have or have not changed their opinion about habitat destruction and animal rights.

LESSON PLAN 1: INTRO TO HABITAT

PURPOSE: The students will learn the point-quarter technique for determining plant density in a forest. They will use this knowledge to compare miniature habitats with one another within the sampling area. Doing this, students will be able to see that even in the same forest, vegetation differs from place to place.

INSTRUCTIONAL OBJECTIVES:

1. Describe how ecologists survey the diversity of plant communities.
2. Learn the point-quarter technique.

ENGAGEMENT: The teacher will ask the students to describe how they think ecologists calculate plant densities in a habitat. Also, the teacher will ask the students why this would be an important thing to know.

EXPLORATION: The students will do the following lab activity.

EXPLANATION: The teacher will lead a discussion about the lab by asking students to compare their mathematical calculations and explaining why sometimes results might be different according to the area surveyed.

EVALUATION: The teacher will grade the lab reports as a means of formal evaluation.

Name _____ Date _____

60 Sampling a Plant Community

PURPOSE

To learn the point-quarter technique for determining the plant density of an area.

MATERIALS

Per team of 2–4:

compass	scissors
masking tape	stake
metre stick	string

INTRODUCTION

Reading the landscape can deepen your understanding of biology. The trees of a wooded area have a story to tell. They are good indicators of the state of development of the area and the kinds of animals that live there.

In this lab you will learn the **point-quarter technique** of estimating the number of trees in a community. This simple technique can be used to sample any community of randomly distributed trees or large shrubs.

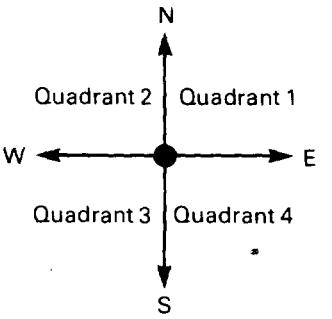
PROCEDURE

Read the following instructions carefully before collecting your data.

To study a stand of trees, first determine the size of the study area. Measure the perimeter, then calculate the area in square metres.

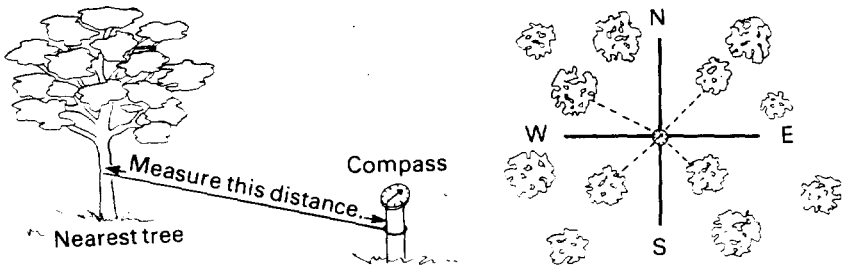
Next, determine the dominant kind of tree (such as oak, maple, or aspen) and learn how to identify it. If several kinds of trees are abundant, choose one for this study.

Each team will randomly select a point in the study area. Mark the point with a stake. Place the compass on top of the stake. Set up four 90° quadrants around the stake as illustrated. It is not necessary to mark off the quadrants. However, it is important to distinguish one quadrant from another.



Next, measure the distance from the stake to the nearest tree in each quadrant. Tie one end of the string to the stake and pull the string to the middle—not the edge—of the tree trunk. Measure the string distance with the metre stick.

Record the distance in metres on the data chart. Note whether the tree was dominant (the kind being studied) or another kind. Under "tree," write "dom." or "other."



Select 19 more points at random in the study area and repeat the procedure for each point.

Procedure Summary:

1. Select your first position.
2. Put stake in ground.
3. Determine quadrants by placing compass on stake.
4. Measure distance from stake to center of nearest tree in the first quadrant with string and metre stick.
5. Identify tree as "dominant" or "other."
6. Record data on chart.
7. Repeat steps 4-6 for each quadrant.
8. Remove stake and move to your next point.

After you have completed your measurements, make the following calculations. Add the four distances for each stake position and record the total in the "Total Distance" box. Calculate the grand total by finding the sum of the figures in the last column; record the grand total.

ANALYSIS

1. Calculate the mean distance between the trees and the stake.

$$\text{mean distance} = \frac{\text{grand total}}{80 \text{ (total number of measurements)}}$$

2. Calculate the mean area per tree by squaring the mean distance.

$$\text{mean area per tree} = (\text{mean distance})^2$$

Name _____ Date _____

Station	Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4		Total Distance
	tree	distance	tree	distance	tree	distance	tree	distance	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

Tree being studied _____ Grand Total _____

3. Calculate the total density of all the trees in the area: divide the total study area by the mean area per tree.

$$\text{total density of trees in area} = \frac{\text{total study area } (m^2)}{\text{mean area per tree } (m^2)}$$

4. Calculate the relative density of the dominant tree. This will give the percentage of dominant trees in the study area. Also record the name of the dominant tree.

$$\text{relative density} = \frac{\text{total number of dominant trees on chart}}{\text{total number of trees examined (80)}} \times 100$$

On the chalkboard, record the team data for the total density of trees per area and the relative density for your tree.

5. Calculate the class average for total density and the class average for your tree.

6. How do your data compare with the class average?

_____

_____

_____

7. What does the density and type of dominant tree in your study area tell you about the area? What types of animals would live there? Is this a community in transition (for example, from marsh to forest), or an established climax community?

_____

_____

_____

_____

_____

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LESSON PLAN 2: HABITTRECKING LAB (2DAYS)

PURPOSE: The students will explore the environment around them in a closer way. They will be asked to observe things in their surroundings which they may not have noticed before. They will discover that they live in a habitat, just as the animals and plants do.

INSTRUCTIONAL OBJECTIVES:

1. Summarize evidence about the nature of habitats; 2)Generalize from evidence that all things have basic needs.

ENGAGEMENT: The teacher will ask students what they expect to find in the habitat they are about to explore. They will take notes and compare their expectations to what they actually observe during the activity.

EXPLORATION: The lab on the next page is the exploration.

EXPLANATION: The day after the exploration has been completed, the students will give their own explanations in the form of a presentation to the entire class. Each member of the group is required to participate.

EVALUATION: The students will be evaluated according to amount of data gathered, and according to the organization of their presentations.

HABITREKKING

Objectives
Students will be able to: 1) summarize evidence about the nature of habitats; and 2) generalize from evidence that people and wildlife have similar basic needs, share environments, and are subject to the same or similar environmental problems.

Method
Students go outside to conduct an investigation requiring observation, interpretation, and data-gathering skills, and then prepare and present their findings.

Background
NOTE: Use this activity after one that introduces components of habitat. See "Ants On A Twig," "Habitat Lap Sit," and "Habitat Rummy."

All animals—including people, pets, and wildlife—share similar basic needs. We have more in common than we may think.

All animals need some place to live. The term for an area in which an animal lives is "habitat." Habitat includes food, water, shelter, and space in a suitable arrangement. People, domesticated animals, and wildlife all have these needs.

Once we recognize the diversity of wildlife, we should realize that wildlife exists all around us. Wildlife is present in areas all over the earth's surface. We share our environment with wildlife. And, since people and wildlife share similar basic needs, it is likely that if people are without elements of their basic needs, wildlife will be as well. More often the case, wildlife habitat is destroyed without people being aware that this has happened. The health and well-being of people, domesticated animals, and wildlife is dependent upon environmental quality.

The major purpose of this activity is for students to recognize that people and wildlife share environments, have similar basic needs, and are subject to the same or similar environmental problems. Students are encouraged to generalize from their findings in investigating microhabitats to come to these conclusions.

Materials
copies of "Habitrekking Evidence Lists" (see below); mixed media available for students to create visual and verbal reports.

Age: Grades 7—12
Subjects: Science, Language Arts, Social Studies
Skills: analysis, application, comparing similarities and differences, description, discussion, generalization, invention, media construction, observation, reporting, research, small group work, synthesis, writing
Duration: two or three 45-minute periods
Group Size: three groups, with a minimum of two students each
Setting: outdoors and indoors
Conceptual Framework Reference: I.A., I.A.1., I.A.2., I.A.3., I.A.4., I.B., I.B.1., I.B.2., I.B.3., I.B.4., I.C., I.C.1., I.C.2., I.C.3., I.C.4.
Key Vocabulary: evidence, wildlife, habitat, environmental quality, pollution

Procedure

1. Divide the students into three groups. Have the students in each group pair off into two-person teams.
2. Each team should be equipped with observation tools. Students could have one or more of these optional items: hand lens, trowel, camera and film, sketch pad, tape recorder, tape, string, meter stick, empty corked test tubes, microscope slides, paper sacks, small containers with lids, etc. Given advance notice, students might bring in a variety of such "observation tools" from home.
3. Provide "Habitrekking Evidence Lists" for the teams in each group:

GROUP # 1—HABITREKKING EVIDENCE LIST # 1
CAUTION: You may bring back evidence, but be careful to do no harm to the environment, or wildlife.
FIND EVIDENCE THAT:
1. Humans, domesticated animals, and wildlife have similar needs for food, water, shelter, and space in an arrangement suitable for survival.
2. All living things are affected by their environment.
3. Plants support all forms of animal life—including people—either directly or indirectly.

GROUP # 2—HABITREKKING EVIDENCE LIST # 2
CAUTION: You may bring back evidence, but be careful to do no harm to the environment, or wildlife.
FIND EVIDENCE THAT:
1. Humans and wildlife share environments.
2. Wildlife is all around us.
3. Wildlife ranges widely in forms, colors, and adaptations.

GROUP # 3—HABITREKKING EVIDENCE LIST # 3
CAUTION: You may bring back evidence, but be careful to do no harm to the environment, or wildlife.
FIND EVIDENCE THAT:
1. Humans and wildlife are subject to the same or similar environmental problems.
2. The health and well-being of both people and wildlife is dependent upon environmental quality.
3. Environmental pollution in its various forms affects people, domesticated animals, and wildlife.

4. Ask each group to read their "Habitrekking Evidence Lists." Make sure the students have clear definitions of wildlife and habitat. Establish the areas in which the students will be looking for evidence. The school grounds may be used, or urban city centers, forested parks, vacant lots, etc. Establish a length of time for the investigations. Thirty minutes is recommended if the students stay on the school grounds; and one hour if you and they go to an off-campus site. Tell them there is a lot they have to interpret. They should exercise their creativity because there are no real right and wrong answers. They simply have to have reasonable explanations for what they select as evidence. They may *observe*, and they may *infer*. Both are sources of evidence.
5. Send the students "habitrekking." When they return, ask each group to prepare to present their evidence in a form that includes both pictures and words. The teams within each group can compare their findings as they prepare for their group's report.
6. Spend one class period seeing, hearing, and discussing reports.
7. In the discussion, ask the students to summarize what they learned. Emphasize the generalizations that people and wildlife have similar basic needs, share environments, and are subject to the same or similar environmental problems.
Optional: Check the observations and generalizations against resource books or other valid sources to verify the results and correct false impressions.

Evaluation

Using one of the "Habitrekking Evidence Lists," conduct a similar investigation in the environment around your home or neighborhood. Write a brief summary of your findings.

LESSON PLAN 4: ROLE PLAYING

PURPOSE: The students will participate in the following activity in order to try to see another person's perspective regarding environmentalist issues. Sometimes looking at things from a different perspective helps one understand anothers opinion.

INSTRUCTIONAL OBJECTIVES:

1. Assume the role of an assigned person and give a brief speech about your opinion regarding the spotted owl controversy.

ENGAGEMENT: The teacher will ask the students about their own opinion regarding the spotted owl controversy, and the class will have a brief discussion.

EXPLORATION: The role playing activity on the following page will be the exploration activity.

EXPLANATION: The teacher will ask the students if their opinions have changed regarding the spotted owl, if so, why?

EVALUATION: The teacher will informally evaluate students according to their participation in the activity.

Role Playing Exercise

The debate over habitat preservation for the spotted owl in northern California has recently sparked debate all over the country. Because of its rapid demise, the government has set aside preserves for the owl in parts of the forest which normally flourish as important industrial logging areas. As a result, many loggers have experienced lost employment and lumber prices have been forced to increase. State your opinion on this matter if you were:

Governor of California

Unemployed Logger

Environmentalist

College Biology Professor

Owner of a lumberyard in Indiana

Realtor

Housing Contractor

Park Ranger

Homemaker

Farmer

President of a Plastics Company

Employee of a Steel Mill

Lobbyist for Foreign Lumber

Owner of a Furniture Factory

Member of Audobon Society

LESSON PLAN 5: ARTIFICIAL HABITATS LAB

PURPOSE: The students have learned about different habitats, now it is time to apply that knowledge and create one of their own. Also, students can discover for themselves how zoos can sometimes be a detrimental environment to some animals.

INSTRUCTIONAL OBJECTIVES:

1. Give criteria for a good artificial habitat for a given animal.
2. Design an artifical habitat for a wild animal.

ENGAGEMENT: The teacher will ask students to describe the pros and cons of zoos, a class discussion will ensue.

EXPLORATION: The lab activity on the next page will be the exploration.

EXPLANATION: The students will explain their creations by group presentation.

EVALUATION: The students will be evaluated formally on their written presentation and pictures, and on their oral presentation as well.

ARTIFICIAL HABITATS: A LAB ACTIVITY

Objectives: Students will be able to: 1) Give the criteria which for a good artificial habitat for a given animal; 2) Compare the natural environment of the animal to that of a normal zoo environment and judge how accurately the artificial environment depicts reality.

Method: Students will design a zoo enclosure appropriate for the survival of one of the following animals: Polar bear, Elephant, California condor, Gorilla, and Seal.

Materials: Reference materials about all the animals will be available to the students. Paper, on which each group of students will design their enclosure.

Procedure: 1) Students will divide into groups of four and each group will take an animal; 2) The groups will have to come up with a list of things to consider while designing their habitats, a least ten; 3) They will be aided in their considerations by reference materials which will be available to look up things such as territory size, etc..,; 4) When each group has made their list and designed their habitat they must choose a spokesperson to present the project to the class and explain why they chose the particular design they did.

Evaluation: Students will be evaluated based on the amount of detail in their written presentation, participation in the oral presentation, and amount of research done on the project.

OVERPOPULATION

UNIT OBJECTIVES: OVERPOPULATION

Upon completion of this unit of study the students should be attain the following goals:

1. Describe what limiting factors are and name the major ones.
2. Calculate carrying capacities.
3. Describe what the "s" curve and the "j" curve stand for.
4. Participate in all lab activities.
5. Participate in a debate about government required birth control and human rights. Cite evidence to back up your opinion.
6. Watch a video about human population growth and participate in a class discussion about the video.
7. Write a one page essay about what you have learned about human population growth and how this knowledge has effected your outlook.

LESSON PLAN 2: BIRTH CONTROL DEBATE

PURPOSE: The students should become aware that there is great worry in some third world countries such as india and china that overpopulation will destroy their economic hope. Some governments have installed programs which give incentives to people who undergo sterilization.

INSTRUCTIONAL OBJECTIVES:

1.Participate in the debate and give a supported opinion about the topic.

ENGAGEMENT: The teacher will introduce the topic and then divide students into groups of pro and con.

EXPLORATION: The actual debate will be the exploration activity.

EXPLANATION: After the debate has taken place, the teacher will lead a brief summarizing discussion about the various opinions on this topic.

EVALUATION: The students will be evaluated by their participation in the debate and their attentiveness to what others have pointed out.

LESSON PLAN 3: OH DEER!!

PURPOSE: The students will play a physically active game in which they will participate and learn about limiting factors and survival.

INSTRUCTIONAL OBJECTIVES:

1. Identify three essential components of habitat.
2. Recognize that fluctuations in animal populations are natural.

ENGAGEMENT: The teacher will ask students to tell what they know about local deer populations. Then, the teacher will explain they will simulate a deer population.

EXPLORATION: The lab on the following page is the exploration activity.

EXPLANATION: After students have finished the game the teacher will have the secretary make a graph of the population fluctuation on the board. The class will discuss the reasons why these fluctuations occur .

.LUATION: Students will be evaluated according to their participation and enthusiasm for the activity.

OH DEER!

ctives Students will be able to: d describe food, water, and shelter sential components of habitat; 2) importance of good habitat for ani- ine "limiting factors" and give ex-) recognize that some fluctuations pulations are natural as ecological dergo a constant change.

od Students become "deer" and of habitat in a highly-involving ivity.

kground A variety of factors e ability of wildlife to successfully nd to maintain their populations over se, predator/prey relationships, vary- s of weather conditions from season g., early freezing, heavy snows, flood- t), accidents, environmental pollution, t destruction and degradation are ese factors.

turally-caused as well as culturally- limiting factors serve to prevent wild- ulations from reproducing in numbers than their habitat can support. An excess limiting factors, however, leads to threat- ndangering, and eliminating whole spe- animals.

st fundamental of life's necessities for mal are food, water, shelter, and space in ble arrangement. Without these essential onents, animal cannot survive.

ctivity is designed for students to learn

od habitat is the key to wildlife survival;
population will continue to increase in size some limiting factors are imposed;
miting factors contribute to fluctuations in dlife populations; and
nature is never in "balance," but is constantly anging.

ldlife populations are not static. They con- nuously fluctuate in response to a variety of timulating and limiting factors. We tend to peak of limiting factors as applying to a single pecies, although one factor may affect many pecies. Natural limiting factors, or those modeled after factors in natural systems, tend to maintain populations of species at levels within predictable ranges. This kind of "balance in nature" is not static, but is more like a teeter-totter than a balance. Some species fluctuate or cycle annually. Quail, for example, may start with a population of 100 pairs in early spring; grow to a population of 1200 birds by late spring; and decline slowly to a winter population of 100 pairs again. This cycle appears to be almost totally controlled by the habitat components of food, water, shelter, and space, which are also limiting factors. Habitat components are the most fundamental and thereby the most critical of limiting factors in most natural settings.

This activity is intended to be a simple but powerful way for students to grasp some basic concepts: that everything in natural systems is interrelated; that populations of organisms are continuously affected by elements of their environment; and that populations of animals do not stay at the same static number year after year in their environment, but rather are continually changing in a process of maintaining dynamic equilibria in natural systems. The major purpose of this activity is for students to understand the importance of suitable habitat as well as factors that may affect wildlife populations in constantly changing ecosystems.

Materials

area—either indoors or outdoors—large enough for students to run; e.g., playing field; chalkboard or flip chart; writing materials

Age: Grades 4—12
Subjects: Science, Math, Social Studies, Physical Education
Skills: application, comparing similarities and differences, description, discussion, generalization, graphing, kinesthetic concept development, observation, psychomotor development
Duration: 30—45 minutes
Group size: 15 and larger recommended
Setting: indoors or outdoors; large area for running needed
Conceptual Framework Reference: I.C.2., III.B., III.B.2., III.B.3., III.B.5., III.C., III.C.1., III.C.2., III.E., III.E.1., III.E.2., III.F., III.F.1., III.F.2., III.F.3., III.F.4., III.F.5., IV.C., IV.C.1., IV.C.2.
Key Vocabulary: habitat, limiting factors, predator, prey, population, balance of nature, ecosystem

Procedure

1. Begin by telling students that they are about to participate in an activity that emphasizes the most essential things that animals need in order to survive. Review the essential components of habitat with the students: food, water, shelter, and space in a suitable arrangement. This activity emphasizes three of those habitat components—food, water, and shelter—but the students should not forget the importance of the animals having sufficient space in which to live, and that all the components have to be in a suitable arrangement or the animals will die.
2. Ask your students to count off in four's. Have all the one's go to one area, all two's, three's, and four's go together to another area. Mark two parallel lines on the ground or floor ten to 20 yards apart. Have the [illegible] line up behind one line; the rest of the students line up behind the other line.
3. The one's become deer. All deer need good habitat in order to survive. Ask the students what the essential components of habitat are again: **food, water, shelter,** and **spa[illegible] suitable arrangement.** For the purpos[illegible] activity, we will assume that th[illegible] enough space in which to live. We a[illegible] ing food, water, and shelter. The de[illegible] need to find food, water, and shelte[illegible] survive. When a deer is looking for f[illegible] clamp its hands over its stomach. Wh[illegible] ing for **water,** it puts its hands over[illegible] When it is looking for **shelter,** it hol[illegible] together over its head. A deer can ch[illegible] for any one of its needs during each [illegible] ment of the activity; **the deer can[illegible] change what it is looking for;** e.g., [illegible] what is available, during **that r[illegible]** change again what it is looking for [illegible] round, if it survives.
4. The two's, three's, and four's are [illegible] and shelter—components of habit[illegible] dent gets to choose at the begin[illegible] round which component he or she w[illegible] that round. The students depict [illegible] ponent they are in the same way the [illegible] what they are looking for; that is, [illegible] stomach for food, etc.

game starts with all players lined up on spective lines (deer on one side; habitat ments on the other side)—and **with their to the students at the other line.**

facilitator or teacher begins the first by asking all of the students to make their s—each deer deciding what it is looking for, habitat component deciding what it is. Give udents a few moments to get their hands ce—over stomachs, mouths, or over their . (As you look at the two lines of students, ll normally see a lot of variety—with some nts water, some food, some shelter. As the proceeds, sometimes the students confer each other and all make the same sign. okay, although don't encourage it. For ex- , all the students in habitat might decide shelter. That could represent a drought with no available food or water.)

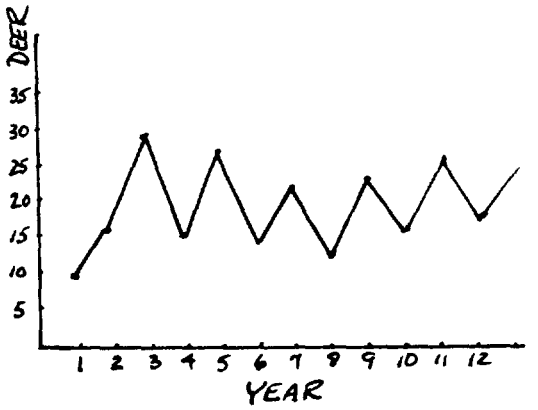
hen you can see that the students are ready, t: "One. . . two. . . three." At the count of e, each deer and each habitat component to face the opposite group, continuing to their signs clearly.

When deer see the habitat component they , they are to run to it. Each deer must hold sign of what it is looking for until getting he habitat component person with the same . Each deer that reaches its necessary itat component takes the "food," "water," or elter" back to the deer side of the line. This represent the deer's successfully meeting eeds, and successfully reproducing as a ult. Any deer that fails to find its food, water, shelter dies and becomes part of the habitat. at is, in the next round, the deer that died is habitat component and so is available as food, ater, or shelter to the deer who are still alive. OTE: When more than one deer reaches a abitat component, the student who gets there rst survives. Habitat components stay in place n their line until a deer needs them. If no deer eeds a particular habitat component during a round, the habitat component just stays where it is in the habitat. The habitat person can, however, change which component it is from round to round.

9. You as the facilitator or teacher keep track of how many deer there are at the beginning of the game, and at the end of each round you record the number of deer also. Continue the game for approximately 15 rounds. Keep the pace brisk, and the students will thoroughly enjoy it.

10. At the end of the 15 rounds, gather the students together to discuss the activity. Encourage them to talk about what they experienced and saw. For example, they saw a small herd of deer (seven students in a class size of 28) begin by finding more than enough of its habitat needs. The population of deer expanded over two to three rounds of the game, until the habitat was depleted and there was not sufficient food, water, and shelter for all the members of the herd. At that point, deer starved or died of thirst or lack of shelter, and they returned as part of the habitat. Such things happen in nature also.

11. Using a flip chart pad or an available chalkboard, post the data recorded during the game. The number of deer at the beginning of the game and at the end of each round represent the number of deer in a series of years. That is, the beginning of the game is year one; each round is an additional year. Deer can be posted by five's for convenience. For example:



The students will see this visual reminder of what they experienced during the game: the deer population fluctuated over a period of years. This is a natural process, as long as the factors which limit the population do not become excessive, to the point where the animals cannot successfully reproduce. The wildlife populations will tend to peak, decline, and rebuild, peak, decline, and rebuild—as long as there is good habitat and sufficient numbers of animals to successfully reproduce.

12. In discussion, ask the students to summarize some of the things they have learned from this activity. What do animals need to survive? What are some of the "limiting factors" that affect their survival? Are wildlife populations static, or do they tend to fluctuate, as part of an overall "balance of nature?" Is nature ever really in "balance," or are ecological systems involved in a process of constant change?

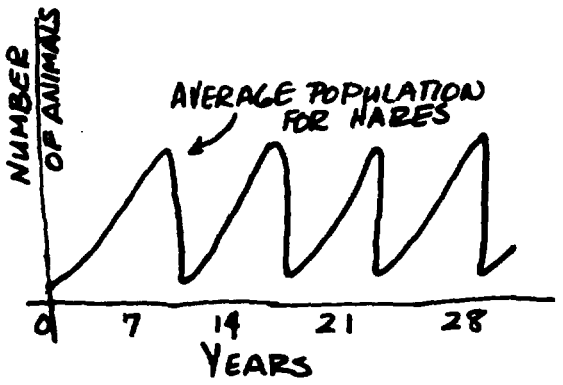
Extensions

1. When you have finished tabulating the graph data and discussing it, ask the students if they

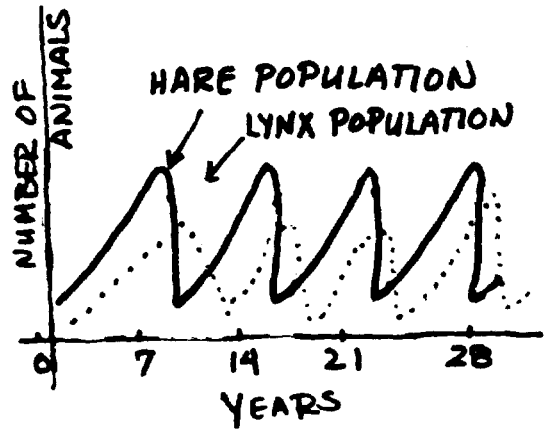
have ever heard of the Hudson Bay trappers in American history. Tell them, briefly, who they were.

There is a hundred years, or more, of records of the activities of these trappers. In those records are some interesting data. These data refer to pelts shipped from America to Europe, particularly the pelts of snowshoe hares and lynx.

Researchers have found that snowshoe hare populations seem to peak about every seven to nine years and then crash, repeating the process over each comparable time period. So, a snowshoe hare population graph would look like this:



It has also been discovered that lynx populations do the same thing—except that they do it one year behind the hare populations. The combined graph would look like this:



Graph this right over the deer graph that you made, adding first the hares, and then the lynx. Ask the students:

- Which animal is the predator? Which prey?
- Are predators controlling the prey, or are prey controlling the predators? (We have been brought up to "know" that predators control the prey—and are now discovering that this is not so. The number of prey animals available tells us how many predators can live in the area.)
- Is this like the deer habitat game we just played? Who controls? (Sometimes the habitat—when the deer population is not too large; sometimes the habitat—when the deer population "gets on top of it" and destroys the vegetative food and cover.)

2. Some recent research has added a new dimension to the story of the snowshoe hares and the lynx.

It has been found that a major winter food of the hare is a small willow. As hare populations grow, the use of the willow plants grows too. But, when the willow plant has been "hedged" or eaten back so far, the plant generates a toxin (poison) which precludes use by the hare. That is when the hare population crashes, followed by the crash of the lynx population about a year later. Then the willow, relieved of pressure, begins to grow again. The hare population begins to grow in response, and last of all, within a year or so, the lynx population follows. And the cycle has begun again—over and over—every seven to nine years.

Discuss the "balance of nature." Is it ever in "balance?"

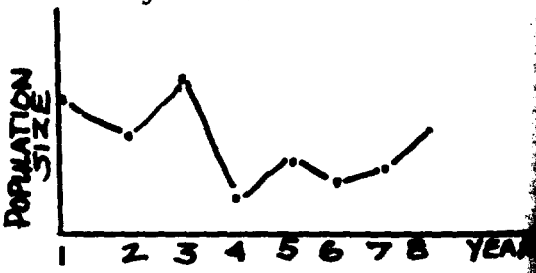
Evaluation

Name three essential components of habitat.

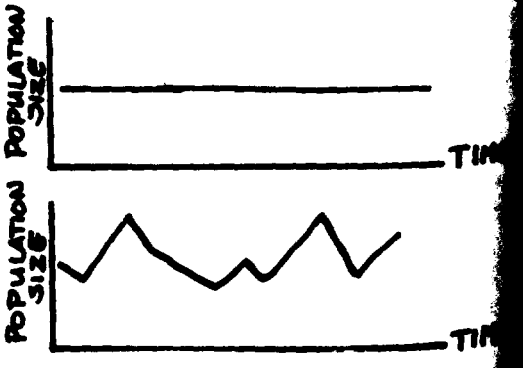
Define "limiting factors." Give three examples.

Examine the graph. What factors may have caused the following population changes:

a. between years 1 and 2?
b. between years 3 and 4?
c. between years 5 and 6?
d. between years 7 and 8?



Which of the following graphs represents a more typically balanced population?



LESSON PLAN 5: POPULATION GROWTH LAB

PURPOSE: To learn how populations actually grow, using mathematics and graphs.

INSTRUCTIONAL OBJECTIVES:

1. Graph population growth.
2. Figure analysis questions related to population growth mathematics.

ENGAGEMENT: The teacher will tell students how, once again, they may not escape math as an integral part of science.

EXPLORATION: The following lab activity is the exploration activity.

EXPLANATION: Following completion of the lab, students may ask questions about specific parts which they may not have understood. The teacher will point out important ideas to know from the activity also.

EVALUATION: The teacher will grade the lab reports which will be used as a formal evaluation, and will utilize questions as an informal evaluator.

Name _____ Date _____

58 Population Growth

PURPOSE

To learn how populations grow.

MATERIALS

paper pencil

INTRODUCTION

Many species produce large numbers of offspring, which is necessary to ensure their survival. Think of all the seeds produced by a single dandelion flower. Very few actually survive and reproduce.

Vertebrates produce fewer offspring than do invertebrates, but a greater percentage of vertebrate offspring survive to maturity. This is certainly true of humans. In this lab you will investigate where the human population may be headed during your lifetime.

PROCEDURE

Your first population growth study will be of pennies.

Assume that you start with one penny. By cleverly investing, you double your money each day for twenty days. A progression of numbers in which each number is twice the preceding number is known as a **geometric progression.**

In your investment, the rate of increase is 100 percent per day. However, although the *rate* of increase is a constant, the actual *amount* of the increase varies.

1. On the data chart, calculate how much money you would have at the end of twenty days.

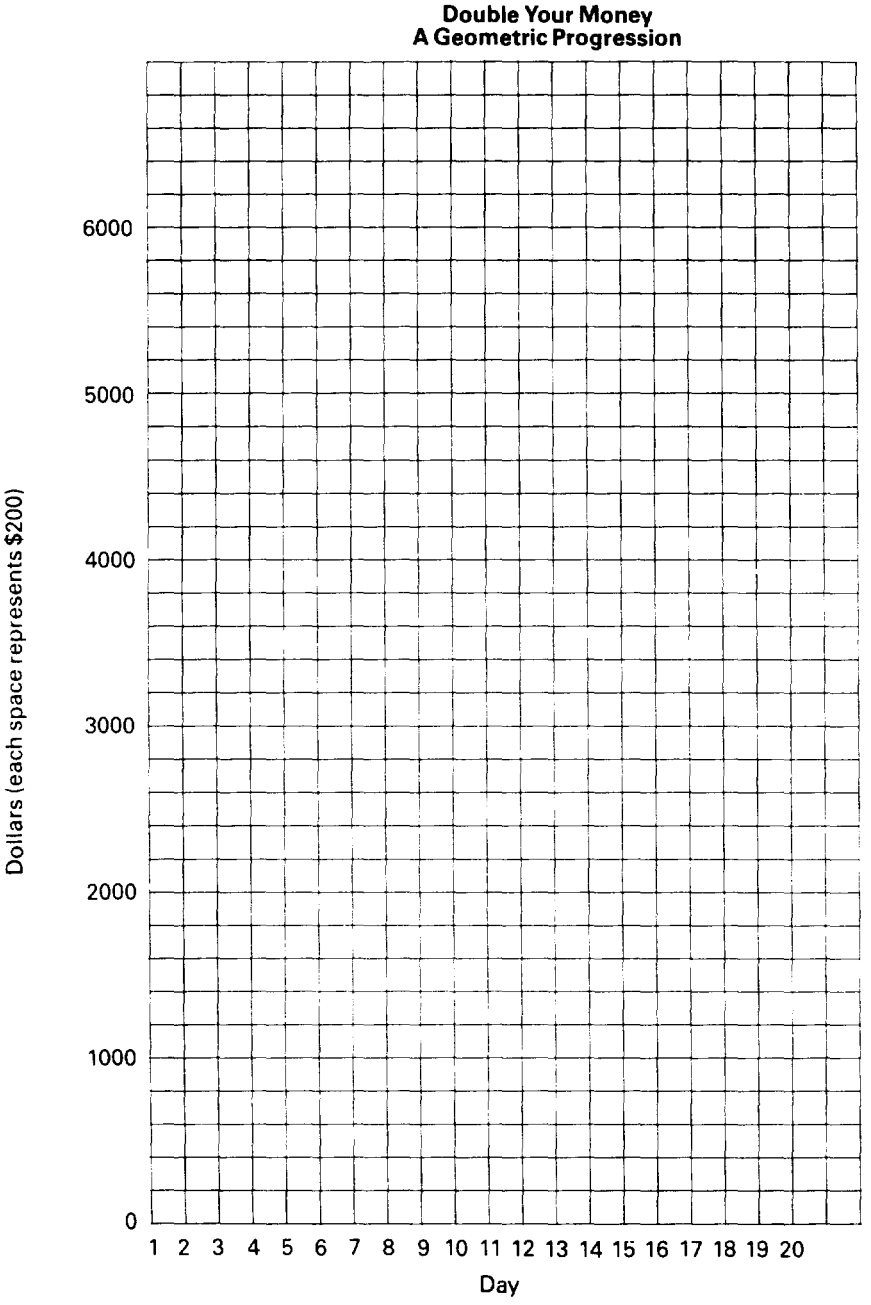
Double Your Money

Day	*Amount*	*Day*	*Amount*
1	$.01	6	
2		7	
3		8	
4		9	
5		10	

Double Your Money (continued)

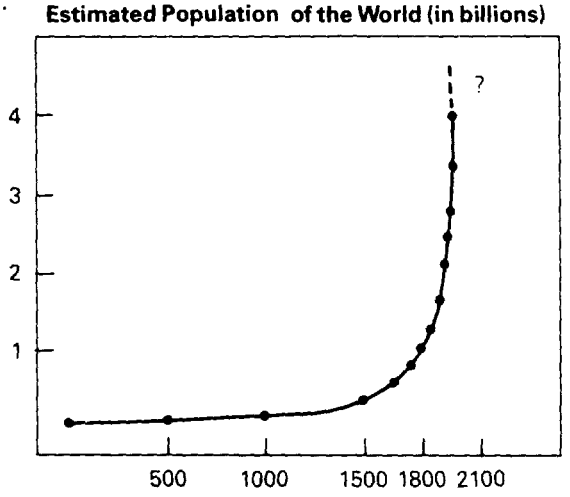
Day	*Amount*	*Day*	*Amount*
11		16	
12		17	
13		18	
14		19	
15		20	

2. Plot the data on the following graph. Note that each space on the Y-axis represents $200.



Name _____ Date _____

Compare your graph with the graph of human population growth. The world population is increasing at a rate of approximately 1.7 percent per year.



3. Since the rate of increase remains the same, how do you account for the sharp upward curve?

_____

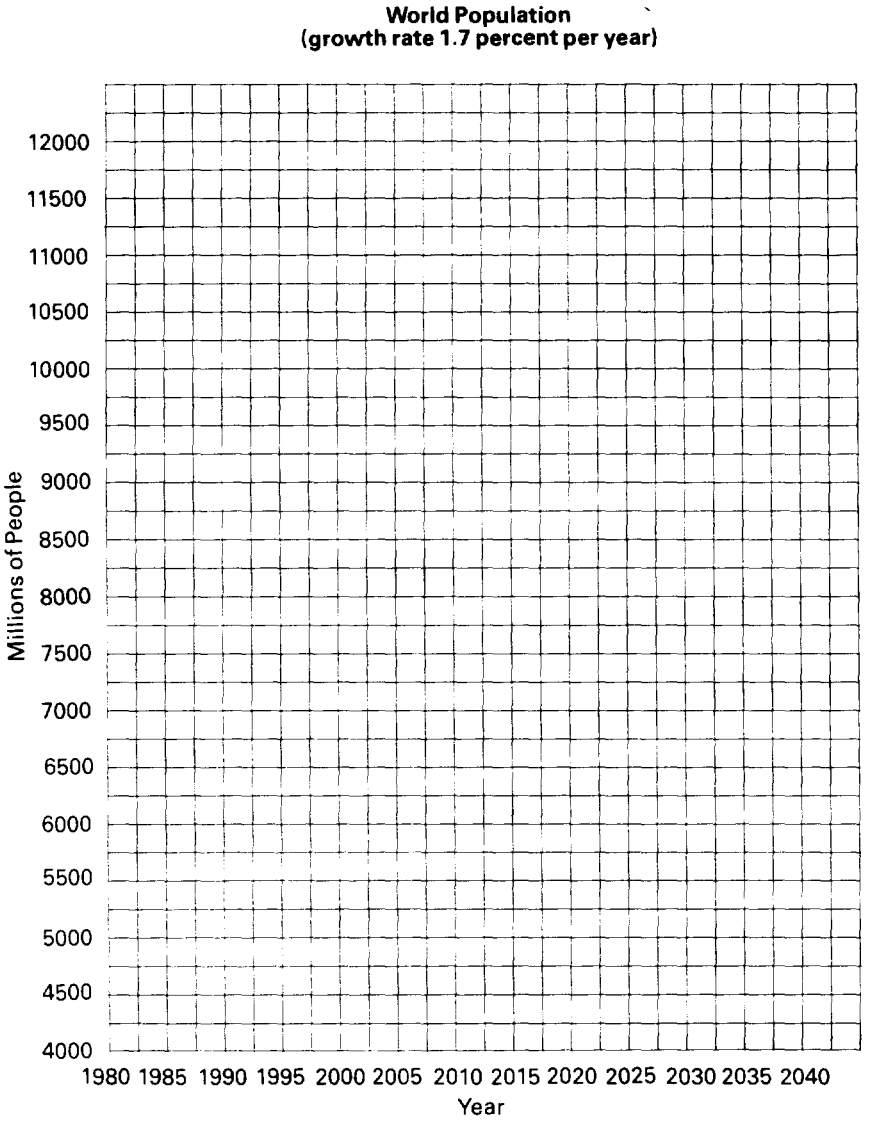
_____

In the following chart, the world population growth is calculated to the year 2040, using 1.7 percent as a yearly increase.

World Population
(Growth rate 1.7 percent per year)

Year	*Population in Millions*
1980	4350
1985	4750
1990	5150
1995	5600
2000	6100
2005	6650
2010	7250
2015	7900
2020	8600
2025	9300
2030	10 150
2035	11 050
2040	12 000

4. Plot the data on world population growth on the following graph.



Name _____ Date _____

In 1980 the population of the United States approached 250 million people. Each space on the Y-axis of the world population graph represents an increase of 250 million people—the approximate population of the United States in 1980.

5. Starting from 1985 on the graph, determine the approximate number of years it will take the world population to increase by 250 million (assuming a steady growth rate).

_____

6. Starting at 2035 on the graph, determine the approximate number of years it will take the world population to increase by 250 million (assuming a steady growth rate).

_____

The total landmass of the earth is about 148 million square kilometres, only about half of which is inhabitable by humans. In 1980 the density of people in the world was about 29 people per square kilometre.

7. If the world population in the year 2040 were to reach 12 billion as shown on your graph, what would be the population density per square kilometre?

_____

The limits of population growth are determined by the amount of space and energy (food) available. At a certain point, insufficient food or a change in behavior slow population growth.

Many species of vertebrates seem to have some instinctive method of limiting population size. Elephants mate less frequently if the herd becomes overpopulated. Rats kept in a cage and given adequate food and water will at first increase the size of their population. As the population increases, the young rats are neglected and only about 4 percent survive. Eventually, the rat population will stabilize.

ANALYSIS

8. Do you think that the earth's population will ever reach 12 billion? Why or why not?

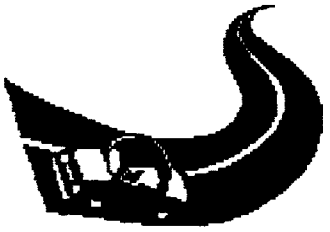
_____

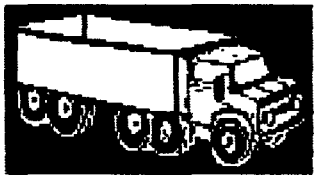
_____

9. In any population certain environmental factors tend to keep the population size under control. What environmental factors could control the size of the human population?

_____

GLOBAL WARMING





UNIT OBJECTIVES: GLOBAL WARMING

Upon completion of this unit students should achieve the following objectives:

1. Learn how to use the SIM EARTH program for the macintosh computer.
2. Perform simulations for the earth adding additional carbon dioxide in order to tell what happens to the weather and to the life forms on earth when an accelerated greenhouse effect is occuring.
3. Interpret data and graphs which SIM EARTH will calculate for a given simulation of the earth.
4. Perform a simulation of the planet Venus, which will show a runaway greenhouse effect.
5. Participate in a debate about whether or not global warming is occuring right now, using evidence from articles assigned by the teacher.
6. Prepare a written synopsis of information gathered as a result of the debate, and give a fact supported opinion based on the debate.

LESSON PLAN 1: GLOBAL WARMING (3 days)

PURPOSE: The students should become aware of just what global warming is and how it occurs. Although this is something quite difficult to demonstrate in the classroom, a computer simulation program will allow students to experiment with variables of carbon dioxide and other greenhouse gasses. This simulation tests what happens to life forms and land form, and weather patterns as a result of changes in these gasses. The students must first learn how to use the program.

INSTRUCTIONAL OBJECTIVES:

1. Learn how to use the SIM EARTH program for macintosh computer.
2. Perform a simulation of the earth in which changes in greenhouse gasses are performed.
3. Perform a simulation of the planet Venus in order to discover what happens during a runaway greenhouse effect.
4. Interpret data and graphs done by the SIM EARTH program.

ENGAGEMENT: The engagement will take one day, because for it, the students must perform the tutorial program for the SIM EARTH software.

The students will run through the tutorial and ask questions of the teacher in order to understand the mechanics of the program.

EXPLORATION: The exploration will take the entire second day, with the students playing a game with variables of greenhouse gasses on the earth to see what would happen to various life forms and weather patterns. The students may interpret graphs made by SIM EARTH from their data.

EXPLANATION: The explanation will take part of a third day, during which students will discuss their results from the use of their individual variables, and they will be asked if they think this is an accurate simulation.

The rest of the day the students can play a short SIM EARTH game in which they examine the evolution of the planet Venus, and the runaway greenhouse effect.

EVALUATION: The teacher will evaluate the performance of the students on the microcomputer as they work on the simulations, and take note of those students who seem to have trouble with the game in order to help them.

LESSON PLAN 2: GLOBAL WARMING DEBATE (2 DAYS)

PURPOSE: The condition of global warming is a hotly debated topic, some believe and some do not. I want the students to take a position, pro or con, to which they will be assigned and debate the controversy in class.

INSTRUCTIONAL OBJECTIVES:

1. Participate in a debate about whether or not global warming is occuring right now, using evidence from articles assigned by the teacher.
2. Prepare a written synopsis of information gathered as a result of the debate, and give a fact-supported opinion based on the debate.

ENGAGEMENT: The engagement activity will take an entire day, in which students do research in the library in order to read up on the topic and gather facts. The class will be divided in two, with each having an opposing view. The following articles are suggested reading for the students who are gathering data for the global warming:

Tooley, Michael. "The flood behind the embankment." Geographical Magazine. Nov. 1989, vol. 61, p.32-4.

"From fire comes ice." Science News. Feb. 8, 1992, vol. 141, p.91.

"Rough justice in the greenhouse." Newsweek. Dec. 18, 1989, vol.114, p. 65.

For students gathering data against the likelihood of global warming, the following articles could be read for reference:

Roberts, Leslie. "Greenhouse role in reef stress unproven." Science. July 19, 1991, vo.253, p.258.

Abelson, Phillip H. "Uncertainties about global warming." Science. March 30, 1990, vol.247, p.1529.

Monastersky, Richard. "Haze clouds the greenhouse." Science News. April 11, 1992, vol.141, p.232.

EXPLORATION: The exploration will take the entire second day and will consist of students having the actual debate. Students will use facts gathered the previous day for their arguments.

EVALUATION: The teacher will evaluate the written synopsis which is required from each person in each group. Further, the teacher will evaluate the oral presentations of the students.

* POLLUTION*

PARTICULATES

ACID RAIN

HEAVY METALS

THERMAL POLLUTION

NUCLEAR WASTE

UNIT OBJECTIVES: POLLUTION

Upon completion of this unit, students should be able to achieve the following objectives:

1. Describe how acid rain affects plant life.
2. Describe how thermal pollution is detrimental to organisms.
3. Make decisions regarding pollution and progress.
4. Tell how chemicals can affect living things.
5. Name ways in which oil spills damage the environment.
6. Trace modern conveniences back to their original energy sources.
7. Tell how pollution could change fish adaptations.
8. Describe how salmon populations have been effected by man.
9. Participate in a debate about whether or not businesses should be strictly penalized for polluting the environment.
10. Watch and discuss a video about chemical waste dumping.

LESSON PLAN 1: ACID RAIN

PURPOSE: The point of studying acid rain is fairly obvious. It has cost countries like Canada millions of dollars in property damage as a result of our negligent pollution control.

INSTRUCTIONAL OBJECTIVES:

1. Describe what acid rain is and how it affects plants.
2. Examine several plants which have been exposed to various acidic pH levels and tell which ones were most effected.

ENGAGEMENT: The teacher will lead a discussion on the origin, and effects of acid rain, as well as examine the political problems which accompany its discussion.

EXPLORATION: The students will examine plants which have been watered with various levels of acidic water. The students must try to distinguish which plants were exposed to the most acidity, and try to estimate the pH at which they were treated.

EXPLANATION: At this time, students will name their estimates and announce their findings to the class. The teacher will reveal the correct approximation, and a discussion will ensue.

EVALUATION: The teacher will evaluate student performance by orally questioning students on their understanding of the topic.

LESSON PLAN 2: THERMAL POLLUTION

PURPOSE: The point of this exercise is to help students consider other types of pollution than those which are conventionally thought of as detrimantal. Because cold-blooded animals have such a restricted temperature range, this activity helps demonstrate the delicate temperature balance some living things must adhere to.

INSTRUCTIONAL OBJECTIVES:

1. Find out if heated water can kill or inhibit grow of yeast cells.
2. Determine if yeast cells can live in heated environment for long periods of time.

ENGAGEMENT: The teacher will ask students to name several types of pollution, and will ask students to describe how thermal pollution could be harmful to organisms.

EXPLORATION: The lab which follows will serve as the exploration.

EXPLANATION: At the completion of the lab, the teacher will ask students to explain their lab results.

EVALUATION: The lab reports will serve as formal evaluation for the teacher to examine.

Name _____ Class _____ Period _____

32–2 How Does Thermal Pollution Affect Living Things?

Sometimes the environment becomes too warm for living things. Thermal pollution is heat that is discharged into the soil, water, or air of a biological community. This heat can harm or kill living things.

Some industries heat water during the process of cooling their electric generators. While still warm, the water is sometimes dumped into small streams or ponds. Many of the organisms that make up the food chains and food webs in these water biomes may be killed.

INVESTIGATION

OBJECTIVES

In this exercise, you will:

a. find out if heated water can kill or stop the growth of living things.
b. determine if yeast cells can live in heated water for a short time.

KEYWORDS

Define the following keywords:

community _____

environment _____

food chain _____

food web _____

thermal pollution _____

MATERIALS

4 test tubes	toothpick	5 droppers	yeast suspension
test-tube rack	glass beaker	glass slide	blue stain
test-tube holder	hot plate	coverslip	microscope
clock with second hand	marking pen		

PROCEDURE

Part A. The Effect of Heat on Yeast

1. Label four test tubes 1 to 4. Place the test tubes in the rack.
2. Fill each test tube 1/3 full with tap water.
3. Add five drops of yeast suspension to each test tube as shown in Figure 1.
4. Shake the tubes back and forth to mix the yeast cells in the water.

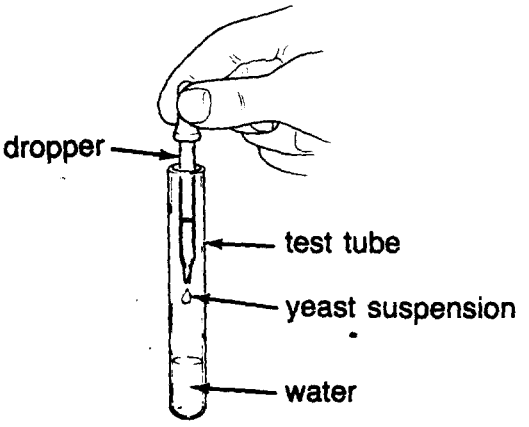


FIGURE 1. Adding yeast suspension

5. Heat a beaker of water to boiling over a hot plate.
6. Attach a test-tube holder to tube 2 and hold it in the boiling water for 20 seconds as shown in Figure 2. Then return it to the rack. **CAUTION:** *Always use the test-tube holder when placing the test tubes in or out of the boiling water.*
7. Repeat this process for test tube 3 but keep the test tube in the water for 40 seconds.
8. Repeat this process for test-tube 4 for 60 seconds.
9. Stir up the yeast cells in test tube 1 by filling a dropper with the yeast solution and squirting it back into the tube three times.
10. Place one drop of yeast solution from test tube 1 on a clean slide.
11. Using a clean dropper, add a drop of blue stain to the drop of yeast.
12. Use a toothpick to mix the stain with the drop of yeast solution.
13. Add a coverslip. Locate the yeast cells on low power and then turn to high power. Yeast cells will appear as small dots on low power. Look at Figure 3 to see their appearance at high power.

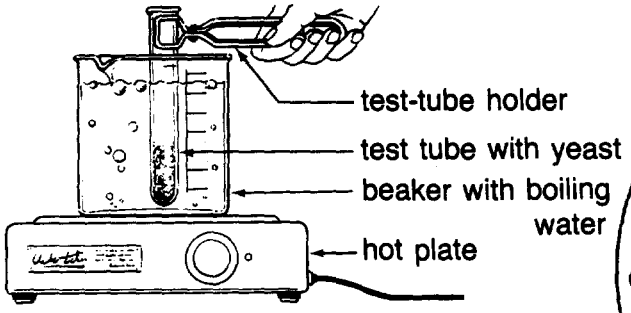


FIGURE 2. Heating yeast

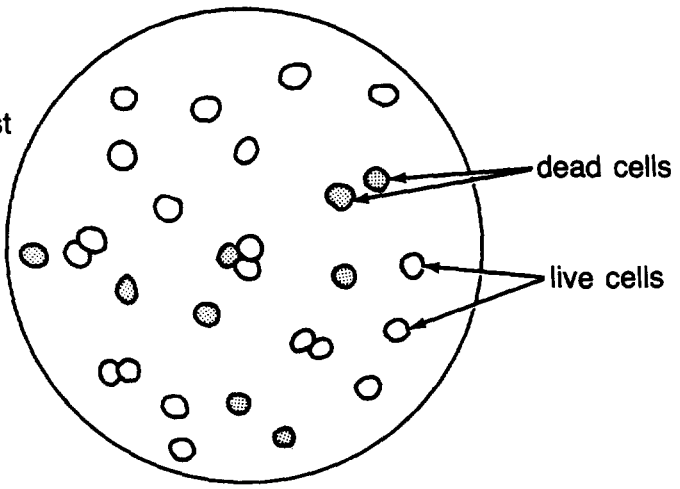


FIGURE 3. Yeast cells

14. Look for live yeast cells. These will appear very light blue in color. Look for dead yeast cells. These will have the same dark blue color as the stain on the slide.
15. For each yeast cell in one field of view, make a mark in Table 1 to show if it is alive or dead. Continue counting until 50 cells have been recorded. If there are less than 50 cells in one field of view, move to another area of the slide and continue counting until 50 has been reached.
16. Repeat steps 9 to 15 with test tubes 2, 3, and 4.

Table 1. Number of Yeast Cells

Test tube	Time in boiling water	Number of live yeast cells	Number of dead yeast cells	Total number of cells counted
1	0 seconds			
2	20 seconds			
3	40 seconds			
4	60 seconds			

Name _____ Class _____ Period _____

Part B. Plotting the Data

Using the data recorded in Table 1, plot two bar graphs in Figure 4 to show the number of live and dead cells in each tube.

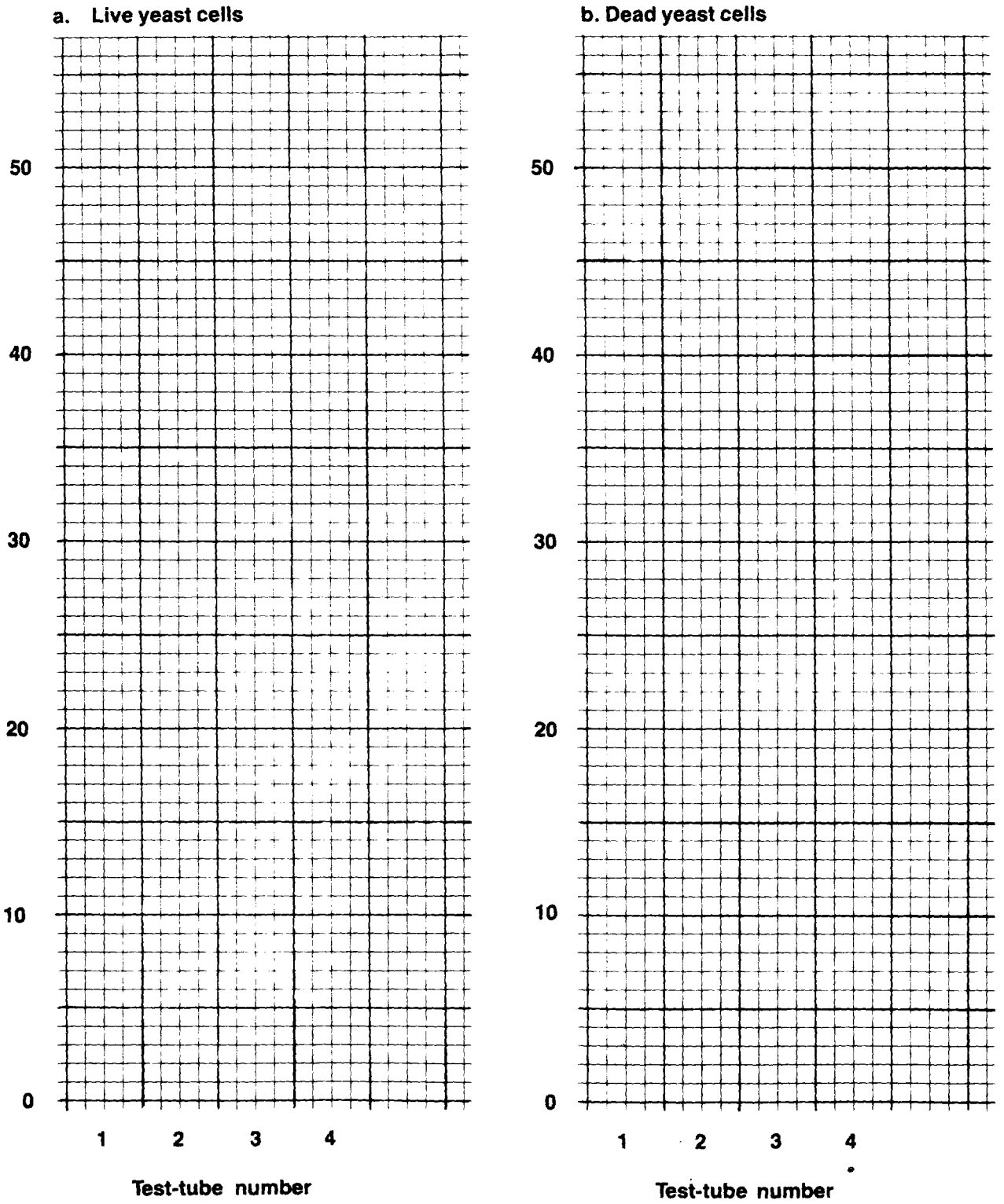


FIGURE 4. Bar graphs

QUESTIONS

1. Which tube contained the most live cells?_____

2. Why were so many cells in this tube alive?_____

_____

3. Which tube contained the most dead cells?_____

4. Why were so many dead cells in this tube?_____

_____

5. Why was test tube 1 not placed in boiling water?_____

_____

6. Using your results, write three sentences that explain what thermal pollution is.

_____

_____

_____

7. Suppose that algae living in a stream react the same way as yeast cells did in this exercise. What would happen to food chains in the stream if thermal pollution occurred?_____

_____

8. A new industry wants to move to your town. This industry wants to use water from the local river for its production line. What questions should the townspeople ask the new industry about the water?_____

_____

_____

LESSON PLAN 3: DRAGONFLY POND

PURPOSE: The point of this exercise is to show students how they may someday become involved in a campagn in their own community to prevent pollution. The delicate banance between progress and preservation will be examined.

INSTRUCTIONAL OBJECTIVES:

1. Discuss lifestyle changes to minimize pollution.
2. Evaluate effects of different kinds of land use on wetland areas.

ENGAGEMENT: The teacher will introduce the lab by asking students if they have ever had a controversy such as this one in their community.

EXPLORATION: The lab activity which follows is the exploration.

EXPLANATION: The groups of students will present their design to the class and the class will critique the effectiveness of pollution prevention.

EVALUATION: The teacher will formally evaluate the design of each group, as well as informally evaluate by orally questioning.

DRAGONFLY POND

ctives

will be able to: 1) evaluate the effects nt kinds of land use on wetland habi- 2) discuss and evaluate lifestyle to minimize damaging effects on

hod

create a collage of human land-use around an image of a pond.

kground

man use of land affects wildlife habitat, y or negatively. What humans do with a reflection of human priorities and life- The search for a modern day "good life" of its conveniences produces mixed for wildlife and the natural environment. mes people see undeveloped areas of environment as little more than raw al for human use. Others believe that the environment is to be preserved without for human needs. Still others yearn for ance between economic growth and a y and vigorous natural environment. Very differences of opinion regarding balance between well-meaning people.

he core of land use issues is the concept of th. Growth in natural systems has inherent s, imposed by a dynamic balance of energy ween all parts of the system. Energy in ural systems is translated into food, water, lter, space, and continued survival. This ans that the vitality of natural systems is pressed by their ability to be self-regulating. is capacity for self-regulation makes it possible all natural members of an ecosystem to live harmony. All the life forms of any ecosystem ust be considered. The microbes in the soil are ust as necessary to a habitat as the plants and redators. It is this natural dynamic balance, with all its inherent and essential parts, that much of human land use has tended to disturb. Human activities can often go beyond the natural limits of a setting. Humans have the ability to import energy sources that allow a system to exceed its natural limits—or to remove energy sources that are necessary for a system to stay in balance. For example, people can build dams to create power, water can be captured for irrigation, wetlands can be drained for homes and buildings. All of these activities affect wildlife habitat.

Age: Grades 4—12
Subjects: Science, Social Studies
Skills: analysis, application, classification, communication, comparing similarities and differences, description, discussion, drawing, evaluation, generalization, inference, interpretation, invention, listening, listing, mapping, media construction, prediction, problem solving, psychomotor development, small group work, synthesis, using time and space, visualization
Duration: one to three 45-60 minute periods
Group Size: designed for a classroom of several small groups; can be modified to be an individual activity
Setting: indoors
Conceptual Framework Reference: VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7., VI.A., VI.A.2., VI.A.3., VI.A.4., VI.A.5., VI.B. VI.B.1., VI.B.2., VI.B.3., VI.B.4., VI.B.5., VI.B.6., VI.C., VI.C.2., VI.C.12., VI.C.15., VI.C.16., VI.D., VI.D.1.
Key Vocabulary: land use planning, wetlands, tradeoffs, lifestyle